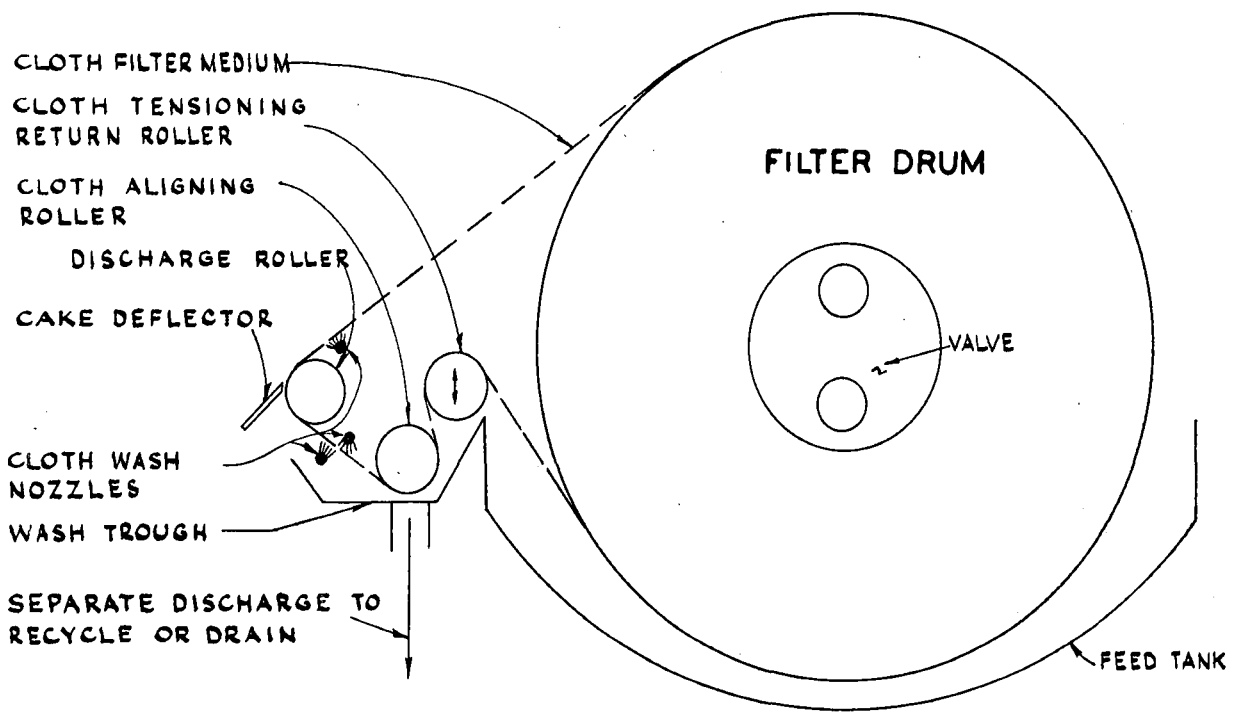
FILTRATE RECIRCULATION ELIMINATED AT UMZIMKULU

By A. E. RABE

The recycling of filtrates from filter presses and vacuum filters has long been accepted as standard practice, but that this practice has never been approved is shown by the numerous systems of separate treatment for filtrates which have been introduced, their aim being to get these thin juices to the evaporator as quickly as possible without the endless return of impurities to the clarifiers. Filtrates from standard vacuum filters have never been clear enough to mix with clarified juice. Juice from the filter presses while clear enough is mostly obtained from mud which has been limed to a high pH to improve filtration and which cannot be mixed with clarified juice because of precipitation which would result.

At Umzimkulu we have two clarifiers which, during periods of poor settling, are slightly under capacity, therefore the possibility of eliminating this bottleneck by the simple expedient of reducing the volume of juice fed to the clarifier, and at the same time getting the benefits of having all thin juices concentrated in the shortest possible time, appeared to us to be worthwhile, and it was decided to convert one of our two 8 ft. by 12 ft. Eimco filters to the Eimco Belt System.

The conversion kit, the mechanical parts of which are bolted to the existing structure, consists of the "belt", made of a closely woven polypropylene fabric, which passes round the drum, over a discharge roll, round the aligning roller, over a tension roller, and



BASIC PRINCIPLE OF THE EIMCOBELT FILTER

Fairly recently, however, several brands of flocculants have appeared on the market and these have altered the picture. The addition of minute quantities of this material to clarifier muds (10 to 30 ppm.) coagulates the existing flocs to such an extent that filtration becomes possible without high liming and its adverse effects. Two manufacturers have recently developed equipment to convert standard vacuum filters so that a fabric filter medium can be used to filter cane muds treated with one of these flocculants (Separan AP. 30), and produce a filtrate suitable for evaporation.

back onto the drum where it is laced to the other end of the "belt" first by a type of wire lacing and then a zipper. Two sets of sprays, one on either side of the cloth, placed immediately after the discharge roll, keep the cloth clean, wash water being discharged to drains by means of a trough. An additional set of nozzles placed before the discharge roll, facilitates discharge of cake. (See sketch.)

The cloth has a working range temperature of up to 260° F. and is inert to acids and alkalies encountered in the clarification processes. The cloth is claimed to

have a life of a minimum of 4 months which would make the operating cost here 1.5 cents per ton of sugar, but it is anticipated that 4 months can be exceeded with ease.

The accessory equipment consists of a Separan mixing and storage tank, and a pump which delivers a predetermined quantity of the 0.5 per cent stock solution of Separan AP. 30 to the "contactor", where automatically diluted Separan is mixed with the bagacillo-mixed mud prior to being fed to the filter feed trough.

The conversion was finally completed a few weeks before the end of the 1963/64 season. We found that the equipment functioned very well indeed, and any doubts we had about the ability of the aligning roller to keep the "belt" tracking squarely on the drum, were immediately dispelled. The sensing switches which actuate the aligning roller are sensitive to any sideways movement of the cloth, and corrections are made automatically as they become necessary.

Teething troubles were located in our existing vacuum system and in our hot water supply, as also in the feeding of bagacillo which fluctuated considerably. It was found that a higher vacuum is beneficial to pick-up, drying of the cake, and capacity of the filter. The supply of hot water (minimum 40 p.s.i. and 180° F.) for the cloth washing sprays is one of the keys to successful operation. Our evaporator condensate water supply fluctuated with factory demand and stoppages on the mills. Whenever water to the filter ran short the cloth would blind almost immediately, necessitating shut-down. The required volume of wash water is fairly high (60 g.p.m.), and misuse here can easily lead to shortage. We have installed a small heater to maintain the temperature at 180° F., and we have found it useful when cold water only is available during mill shut-down.

The correct dosage of Separan, once established, was simple to maintain. At first we used Separan at the rate of 0.010 lb. per ton of cane, with the result that the mud was over-flocculated. This condition is similar to that on a standard filter when very thin mud has been mixed with too much bagacillo; it just falls off the back of the drum until the whole feed trough appears to be full of solids, and has to be washed down. The other extreme followed when 0.002 lb. Separan per ton of cane was used. With this amount, the mud appears to be well-flocculated, but the filtrate is dirty and the cloth quickly blinds in spite of any increase in washing water, and the operation has to be stopped. A dosage of 0.004 lb. per ton of cane proved to be satisfactory with regard to filtrate clarity and flocculation. The cost of this application is three to four cents per ton of sugar. The clarity of filtrate was always better than that of clarified juice and is sent directly to the evaporator supply tank.

Comparative analyses of filtrate and clarified juice averaged over two weeks are shown as follows:

	Filtrate	*Clarified Juice*
pH	6.80	7.23
Purity	85.90	86.93
Percentage suspended solids (by volume)	1	4
Kopke clarity	14	11

The filter cake over the same period averaged 2.34 per cent sucrose. This average is from analyses as high as 4 per cent and as low as 0.5 per cent. The reason for this wide range is that our bagacillo supply fluctuates and the solids in mud vary between 25 per cent and 55 per cent (by volume) causing variations in cake thickness. A cake thicker than ¼ inch always has a higher sucrose content. Improvements in bagacillo feed arrangements and control of mud feed should improve matters. We feel confident that sucrose percentage filter cake can be reduced to 1.0 per cent.

The capacity of the filter has been more than doubled by the conversion. Previously two standard filters were used continuously whereas now only one converted machine is in use and is frequently idle to allow muds to thicken in clarifiers. Because of the good quality of the juice we were tempted to filter thinner muds by increasing the underflow from the clarifiers so as to give a larger percentage of a clearer juice, but while the filtration rate was high enough to do this the cake became too thin to be discharged properly.

The question of whether the clarifier capacity has indeed been increased has not conclusively been proved. It appeared at times that there was a higher carry over of solids with clarified juice than before the filtrate was removed from the clarification system. As this coincided with rainy weather, when poor settling rates do occur, we cannot come to a definite conclusion as yet, but the fact that there has been additional carry over with the reduced volume of juice is not encouraging.

A short test was carried out on the last day of the season to ascertain the effect of Separan on the filterability of cold juice without settling. Mixed juice from the primary heaters at 145° F. was limed to 8.0 pH and passed through the filter using the normal dosage of bagacillo and Separan. In order to build up a cake the drum was rotated one quarter turn every 5 minutes. Filtration rate was high and the cake formation good, but the fact that starch removal appeared complete from a mixed juice which showed a high content, suggests that flocculants effective over different pH ranges might be used to advantage with high flow rate filters as an intermediate step in our clarification systems.

Although the Eimco belt system has been in operation for only a few weeks at Umzimkulu, we feel that an advance has been made in our clarification process by the installation of equipment which at last turns the standard Rotary Vacuum "filter" into a true filter with the aid of Separan.

Dr. Douwes Dekker (in the chair): We are fortunate that you agreed to write a paper on results which you have obtained so far with the application of the Eimcobelt system. It is the first time that this system has been applied in South Africa. We have seen it mentioned in various publications, and now we have before us the results of an investigation carried out in Natal.

Mr. Bentley: I have always understood that mixing two juices of different pH, is liable to produce secon-

dary precipitation. I see the pH of the filtrate is 6.80 and of the clarified juice is 7.23. Is there not a danger of further precipitation occurring in the evaporator at some stage after your clarification? I would also like to mention the clarity of the clear juice of 11. That seems to me to be hardly clear juice.

Mr. Rabe: I quite agree with you that 11 does seem very low, but it is a clarified juice. The sugar quality has been recently favourably commented on and frequently Umzimkulu sugar has been specified. I quite agree about the difference in pH, and that there is likely to be secondary precipitation. I am not very pleased with this condition, but I think it is possibly due to the fact that we had not cleaned out a clarifier for about two months, instead of the normal practice of once every four weeks.

Mr. Turner: I am given to understand that Separan is most effective at a pH above 7.6. I am rather surprised that in this system Mr. Rabe did not appear to use any lime whatsoever. He appears to take the mud exactly as it comes from the clarifier.

Mr. Rabe: Actually the lime does increase the clarity from the filter considerably. A short test was carried out with cold juice, the Kopke clarity was 25, that was with juice that had not been settled. It was ordinary mixed juice heated to 145° F. The Kopke there was 25. So the lime does definitely help. Because of what Mr. Bentley just now mentioned about secondary precipitation, we are rather chary about using it, unless we can control it accurately.

Mr. Gunn: I would like to ask Mr. Rabe whether he has figures for the Brix of the filtrate, as these would have made this table more interesting. And the other question is, what was the clarity of the clarified juice before you started doing this method of filtering the mud?

Mr. Rabe: The average Kopke clarity did not vary at all. It was only during periods that we had additional overflow from the clarifiers. The reduction in Brix, or dilution, was in the order of clarified juice 14 Brix to between 10 and 11 for filtrate.

Mr. Dick: Mr. Rabe has written some very good notes considering the short time that he had to experiment with this unit. I might try to add a few figures which were obtained in another test of a complete Eimcobelt filter in Kenya at Mwani. That unit was a 10 by 12. We did manage to get figures taken over a matter of a three day period. I am answering questions from Mr. Gunn and Mr. Turner. In this case the factory was a sulphitation factory. I can only give you one or two figures, as I cannot remember them all. The clarified juice Brix was 15.64 with a pH of 6.7 and a Kopke reading of 22 or 23. A little lime was added to the mud bagacillo mixture, and the mud bagacillo mixture as fed to the filter was 7.2. The filtrate coming from it had a Brix of 15.26 compared with 15.64 for the clarified juice. The pH was 7.1, i.e. slightly higher than the clarified juice and slightly lower than the mud bagacillo mixture. The Kopke reading was 26, 27. In this particular case a test was carried out by putting a sample of the clarified juice and a sample of the filtrate into a half inch test tube, and a half-a-dozen people were asked to say which was which. All but one accepted the filtrate as being the clarified juice.

Mr. Boyes: I am interested in the second last paragraph, because if I read this correctly, what Mr. Rabe has tried to do is this. He has taken the mixed juice and has heated it to a temperature which is below the gelatinisation temperature of starch, so we presume the starch is still there in granule form. He has effected a precipitation with lime, and then passed it through these filters, apparently with the aid of Separan and bagacillo, and has had no trouble. Unfortunately he has not followed it up and told us just how much starch he removed by doing this, but could he elaborate a little bit more, because this seems to be an interesting approach.

Mr. Rabe: I did a very short content test for starch on the mixed juice, with iodine the test was pitch black, so the starch content appeared to be very high. I had no equipment to determine the exact quantity. But with the filtrate there was no indication of colour at all. That was the object of inserting this small piece in the paper, as we have always felt that with the use of Separan it might be possible even with the acid preclarification process, to utilize some of these flocculants which are effective at the lower pH range, and then filter these materials, using the filter as we did, rotating it a quarter of a turn every five minutes, so as to be able to build up a cake. Our filter has an area of 300 square feet. We did not have 25 per cent. submergence at any time, and had difficulty in getting it up to 25 per cent. The level kept dropping all the time, and we could not pump fast enough. In spite of the filter not being made for an operation like that, it really performed remarkably well, because of the Separan. I feel that there might be something in this and that it could be used with a different type of filter.

Mr. van Hengel: Mr. Rabe has reported on a very important matter, namely, the filtration of mud. He apparently only had a couple of weeks experience, under circumstances which were probably not the most favourable. I think we should ask Mr. Rabe to report back to us next year, and also Illovo, and Doornkop, who have somewhat similar processes, and let us have a comparison of this very important work. We will have to make up our minds on this, and the more comparable figures that are available the better it is for us.

Mr. Wagner: Regarding the Oliver filter at Illovo, can Mr. Pole give us any idea if it is working with a cloth on, or has it not been working?

Mr. Pole: For the past season we have not used this filter with the cloth on, although we are using the normal Separan process. And we are returning the filtrates, which are relatively clear, having a Kopke of about 9. They are turbid but clear, and we return them to the liming tanks, but the reason we are not using the cloth is that when we do we have to use the front sprays to keep the cloth from liming, and this does introduce a lot of dilution to the mud, which brings down the filtrate from a Brix of approximately 12 to about 8.

That is the reason we have not used the cloth this past season.

Mr. Fourmond: It appeared at times that there was a higher carry over of solids in clarified juice than before the filtrate was removed from the clarification system. Is it possible that by not returning this filtrate, you get a clarified juice of a higher Brix? We know that settling is virtually proportional to the density.

Mr. Rabe: It must have an effect, because the clarified juice Brix must be higher if you do not add any dilution water to it. There is another theory which somebody has enlarged on. The makers of the Bach clarifier claim that they get upward clarification through the mud, or upward filtration through the mud. I do not know exactly what it means, but the fact is that if you have a lot of mud, the juice that you get from it, near the mud layer, is always much brighter and clearer than that which comes off the top of the filter. With the operation of this machine, it often happens that the mud becomes so thin that we have to shut the machine down. Whether it is due to this very thin mud which is in the clarifier itself, if you do not have this filtration effect, I do not know. Your theory is correct.

Mr. Fourmond: I drew your attention to that because once at Amatikulu we had to crush cane from Entumeni. It was burned and it was terribly rich. We had a lot of carry over. We found for the same amount of imbibition we had a Brix of 18-19 for clarified juice. Normally we ran at about 14. It meant that by adding more water we got better settling.

Dr. Douwes Dekker: You have given us the results of an investigation which was carried out at Umzimkulu, you have included data which we require to make up our minds as to what it all amounts to, and to assess its significance. And what is important, you have very carefully refrained from doing a lot of wishful thinking.